Linking future Gulf Stream warming and increased European winter precipitation in an eddy-rich model

Eduardo Moreno-Chamarro¹, Louis-Philippe Caron², Pablo Ortega¹, Saskia Loosveldt Tomas¹, Malcolm J. Roberts³, Aude Carreric¹, Amanda Frigola¹, and Eneko Martín Martínez¹

¹Barcelona Supercomputing Center (BSC), Barcelona, Spain (eduardo.moreno@bsc.es)
²Ouranos, Montreal H3A 1B9, Canada
³Met Office, Exeter EX1 3P8, United Kingdom

This contribution discusses future changes in Gulf Stream temperatures, winter precipitation over northwestern Europe, and their connection. We compare HighResMIP historical and ssp5-8.5 scenario simulations generated with five different configurations of the global coupled model HadGEM3-GC3.1, including one at a pioneering 50-km-atmosphere–1/12°-ocean global resolution. The highest resolution model projects an increase in winter rainfall over Europe outside or to the extremes of multimodel ensembles, such as CMIP6 and HighResMIP, for which both the highest ocean and atmosphere resolutions are essential: on the one hand, only the eddy-rich ocean (1/12°) projects a progressive northward shift of the Gulf Stream and substantial surface warming of the region; on the other, only the 50-km atmosphere translates such warming into strengthened extratropical cyclone activity over the North Atlantic and, hence, increased rainfall over Europe. The results suggest that climate projections relying on traditional ~100-km-resolution models might underestimate climate changes in the North Atlantic and Europe, demonstrating the importance of improved Gulf Stream representation for robust uncertainty estimates of climate risk.

We also present the first results of the STREAM project, which aims to study the role of the ocean mesoscale in driving North Atlantic and European climate variability and predictability. We describe the results of the HighResMIP simulations generated with the EC-Earth global climate model at the T1270-ORCA12 resolution (about 15 km in both the atmosphere and the ocean) and explore the main model biases and response to climate change, as well as the variability in the North Atlantic circulation associated with subpolar oceanic deep mixing.